Claims

1. A method for pulverizing material and extracting moisture from material, comprising:

providing an airflow generator in communication with a venturi;

the airflow generator generating an airflow through the venturi and towards the airflow generator;

introducing the material into the airflow; and

passing the material through the venturi to extract moisture and pulverize the material.

2. The method of claim 1, further comprising passing the pulverized material through an input aperture of the airflow generator.

3. The method of claim 1:

disposing the airflow generator within a housing; and

passing the pulverized material through an exhaust pipe coupled to an outlet of the housing.

4. The method of claim 3, further comprising inclining the exhaust pipe at an angle ranging from about 25 degrees to about 90 degrees relative to the longitudinal axis of the venturi.

5. The method of claim 3, further comprising providing a flow control valve in the exhaust pipe.

6. The method of claim 3, further comprising:

passing the pulverized material from the exhaust pipe to a cyclone; and

the cyclone separating the pulverized material from air.

7. The method of claim 6, further comprising passing the air from the first cyclone to a second cyclone to remove residual particles from the air.

8. The method of claim 6, further comprising passing the air into a condenser to condense vaporized moisture.

9. The method of claim 1, further comprising blending the material prior to introducing the material into the airflow.

10. The method of claim 9, further comprising blending the material with a drying enhancing agent.

11. The method of claim 1, further comprising introducing the material into a hopper prior to introducing the material into the airflow.

12. The method of claim 1, further comprising heating air upstream of the venturi.

13. The method of claim 1, further comprising monitoring a flow rate of the material upstream of the venturi.

14. The method of claim 1, further comprising:

disposing the airflow generator within a housing;

providing a valve on the diverging portion of the venturi; and

the valve adjusting the air volume and air velocity within the housing and the airflow generator.

15. The method of claim 1, wherein introducing the material into the airflow includes,

providing an inlet tube coupled to the venturi; and

introducing the material into the inlet tube.

16. The method of claim 1, wherein the venturi includes a throat and further comprising introducing a throat resizer into the throat to increase airflow velocity.

17. The method of claim 1, further comprising:

disposing the airflow generator within a housing having an outlet;

introducing a restrictor into the outlet to restrict airflow.

18. The method of claim 1, further comprising:

introducing the pulverized material into the airflow; and

passing the pulverized material through the venturi to further extract moisture.

19. The method of claim 1, further comprising:

measuring a moisture content of the pulverized material;

upon determining that the moisture content exceeds a threshold value, introducing the pulverized material into an airflow; and

passing the pulverized material through the venturi to further extract moisture.

20. The method of claim 1, further comprising:

measuring a particle size of the pulverized material;

upon determining that the particle size exceeds a threshold value, introducing the pulverized material into an airflow; and

passing the pulverized material through the venturi to further pulverize the material.

21. The method of claim 1, further comprising varying the velocity of the airflow to provide a desired particle size of the pulverized material.

22. A method for homogenizing materials, comprising:

providing an airflow generator in communication with a venturi;

the airflow generator generating an airflow through the venturi and towards the airflow generator;

introducing first and second materials into the airflow; and

passing the first and second materials through the venturi to pulverize and homogenize the materials.

23. The method of claim 22, further comprising blending the first and second materials prior to introducing the first and second materials into the airflow.

24. The method of claim 23, further comprising blending the first and second materials with a drying enhancing agent.

25. The method of claim 22, further comprising introducing the first and second materials into a hopper prior to introducing the first and second materials into the airflow.

26. The method of claim 22, further comprising directing heat to the airflow.

27. The method of claim 25, further comprising monitoring a flow rate of the first and second materials together into the airflow.

28. The method of claim 22, further comprising pulverizing the first material by passing the first material through a venturi prior to introducing first and second materials into the airflow.

29. The method of claim 22, further comprising passing the homogenized materials through an input aperture of the airflow generator.

30. The method of claim 29, further comprising:

disposing the airflow generator within a housing having an outlet; and

passing the homogenized materials through an exhaust pipe coupled to the outlet of the housing.

31. The method of claim 30, further comprising inclining the exhaust pipe at an angle ranging from about 25 degrees to about 90 degrees relative to the longitudinal axis of the venturi.

32. The method of claim 30, further comprising providing a flow control valve in the exhaust pipe.

33. The method of claim 30, further comprising:

passing the homogenized materials from the exhaust pipe to a cyclone; and

the cyclone separating the homogenized materials from air.

34. The method of claim 33, further comprising passing the air from the first cyclone to a second cyclone to remove residual particles from the air.

35. The method of claim 22, further comprising:

disposing the airflow generator within a housing;

providing a valve on a diverging portion of the venturi; and

the valve adjusting the air volume and air velocity within the housing and the airflow generator.

36. The method of claim 22, wherein introducing the first and second materials into the airflow includes,

providing an inlet tube coupled to the venturi such that the airflow passes through the inlet tube, and

introducing the first and second materials into the inlet tube.

37. The method of claim 22, wherein the venturi includes a throat and further comprising introducing a throat resizer into the throat to increase air velocity.

38. The method of claim 22, further comprising:

disposing the airflow generator within a housing having an outlet; and

introducing a restrictor into the outlet to restrict airflow.

39. The method of claim 22, further comprising:

introducing the homogenized materials into the airflow; and

passing the homogenized materials through the venturi to further homogenize the first and second materials.

40. The method of claim 22, further comprising:

measuring a moisture content of the homogenized materials;

upon determining that the moisture content exceeds a threshold value, introducing the homogenized materials into an airflow; and

passing the homogenized materials through a venturi to further extract moisture within the homogenized materials.

41. The method of claim 22, further comprising:

measuring a particle size of the homogenized materials;

upon determining that the particle size exceeds a threshold value, introducing the homogenized materials into an airflow; and

passing the homogenized materials through a venturi to further pulverize the homogenized materials.

42. The method of claim 22, further comprising varying the velocity of the airflow to provide a desired particle size of the pulverized materials.

43. An apparatus for pulverizing material and extracting moisture from material, comprising:

an inlet tube;

a venturi coupled to the inlet tube; and

an airflow generator to generate an airflow, the airflow generator in communication with the venturi to direct an airflow through the inlet tube, through the venturi, and toward the airflow generator, wherein material introduced into the airflow passes through the venturi and is subject to pulverization and moisture extraction.

44. The apparatus of claim 43, further comprising a hopper in communication with the inlet tube to receive material and convey material to the inlet tube.

45. The apparatus of claim 44, further comprising a heat generator in communication with the inlet tube.

46. The apparatus of claim 43, further comprising a sensor to monitor the material flow volume to the inlet tube.

47. The apparatus of claim 43, further comprising:

a housing that at least partially encompasses the airflow generator, the housing having an outlet; and

an exhaust pipe, coupled to the outlet.

48. The apparatus of claim 47, wherein the exhaust pipe is inclined at an angle ranging from about 25 degrees to about 90 degrees relative to the longitudinal axis of the venturi.

49. The apparatus of claim 47, further comprising a flow control valve in the exhaust pipe.

50. The apparatus of claim 47, further comprising a restrictor disposed within the outlet to limit airflow.

51. The apparatus of claim 47, further comprising a cyclone coupled to the exhaust pipe to separate air from pulverized material.

52. The apparatus of claim 51, further comprising a second cyclone in communication with the first cyclone to receive air and separate residual particles.

53. The apparatus of claim 51, further comprising a condenser in communication with the cyclone to receive air and condense moisture.

54. The apparatus of claim 43, further comprising a blender to blend material to be introduced into the inlet tube.

55. The apparatus of claim 54, further comprising a conveyance device to convey blended material from the blender to the inlet tube.

56. The apparatus of claim 43, further comprising:

a housing at least partially encompassing the airflow generator; and

a valve disposed on the diverging portion of the venturi to adjust the air volume and air velocity within the housing and the airflow generator.

57. The apparatus of claim 43, wherein the venturi includes, a converging portion, a throat coupled to the converging portion, and a diverging portion coupled to the throat, and wherein the apparatus further comprises a throat resizer disposed within the throat to increase air velocity.

58. The apparatus of claim 43, wherein the inlet tube has a first end configured as a flange.

59. The apparatus of claim 43, further comprising a mobile vehicle supporting the inlet tube, venturi, and airflow generator.

60. An apparatus for pulverizing material and extracting moisture from material, comprising:

an inlet tube;

a venturi coupled to the inlet tube; and

an airflow generator to generate an airflow and including,

a front plate,

an input aperture disposed within the front plate,

a back plate, and

a plurality of blades disposed between and coupled to the back and front plates; and

a housing at least partially encompassing the airflow generator, the housing including an outlet in communication with the input aperture of the airflow generator,

wherein the airflow generator is in communication with the venturi to direct the airflow through the venturi, and toward the input aperture, wherein material introduced into the airflow passes through the venturi and is subject to pulverization and moisture extraction.

61. The apparatus of claim 60 wherein the airflow generator further includes an axel aperture disposed on the back plate.

62. The apparatus of claim 60 wherein each blade includes a wedge portion disposed proximate to a perimeter of the front and back plates, the wedge portion having a thickness greater than the remainder of the corresponding blade.

63. The apparatus of claim 62 wherein each wedge portion increases in thickness as it extends longitudinally from the front plate to the back plate to control the direction of a longitudinal material flow in the airflow.

64. The apparatus of claim 62 wherein each wedge portion includes a removable wear tip.

65. The apparatus of claim 62 wherein each wedge portion is removable to allow replacement.

66. The apparatus of claim 60 wherein each blade transitions from a position perpendicular to the back plate to an inclined position as the blade proceeds to the input aperture.

67. The apparatus of claim 66 wherein the angle of the inclined position of the blade is approximately 20 to 60 degrees from a position perpendicular to the back plate.

68. The apparatus of claim 60 wherein each blade includes a leading edge proximate to the input aperture and a tail edge proximate to a perimeter of the front and back plates, the leading edge having an outward curve portion proximate to the back plate and an inward curve portion proximate to the front plate.

69. The apparatus of claim 68 wherein the leading edge includes an oval shaped cross-section.

70. The apparatus of claim 60 further comprising a plurality of fins disposed on an exterior surface of the front plate and the back plate.

71. The apparatus of claim 60 wherein the housing further includes a diverter plate coupled to the interior of the housing proximate to the outlet and having a cutting edge proximate to the airflow generator.

72. The apparatus of claim 71 wherein the diverter plate is adjustably coupled to the interior of the housing to vary the distance from the cutting edge end to the airflow generator.

73. An airflow generator for providing an airflow, comprising:

a front plate;

an input aperture disposed within the front plate;

a back plate;

an axel aperture disposed within the back plate;

a plurality of blades disposed between and coupled to the back and front plates, wherein each blade transitions from a position perpendicular to the back plate to an inclined position as the blade proceeds to the input aperture,

wherein each blade includes a wedge portion disposed proximate to a perimeter of the front and back plates, the wedge portion having a thickness greater than the remainder of the corresponding blade.

74. The airflow generator of claim 73 wherein each wedge portion includes a removable wear tip.

75. The airflow generator of claim 73 wherein each wedge portion is removable to allow replacement.

76. The airflow generator of claim 73 wherein each wedge portion increases in thickness as it extends longitudinally from the front plate to the back plate to control the direction of a longitudinal material flow in the airflow.

77. The airflow generator of claim 73 wherein the angle of the inclined position of each blade is approximately 20 to 60 degrees from a position perpendicular to the back plate.

78. The airflow generator of claim 73 wherein each blade includes a leading edge proximate to the input aperture and a tail edge proximate to a perimeter of the front and back plates, the leading edge having an outward curve portion proximate to the back plate and an inward curve portion proximate to the front plate.

79. The apparatus of claim 78 wherein the leading edge includes an oval shaped cross-section.

80. The airflow generator of claim 73 further comprising a plurality of fins disposed on exterior surfaces of the front plate and the back plate.

81. An apparatus for pulverizing material and extracting moisture from material, comprising:

an inlet tube;

a venturi coupled to the inlet tube, wherein the venturi includes,

a converging portion,

a throat coupled to the converging portion, and

a diverging portion coupled to the throat;

an airflow generator to generate an airflow and including an input aperture;

a housing at least partially encompassing the airflow generator and including an outlet in communication with the input aperture,

the airflow generator in communication with the venturi to direct the airflow through the venturi, and toward the input aperture, wherein material introduced into the airflow passes through the venturi and is subject to pulverization and moisture extraction;

an exhaust pipe coupled to the outlet; and

a cyclone coupled to the exhaust pipe to separate air from pulverized material.

82. The apparatus of claim 81, further comprising a blender to blend material to be introduced into the inlet tube.

83. The apparatus of claim 81, further comprising a conveyance device to convey bended material from the blender to the inlet tube.

84. The apparatus of claim 81, further comprising a throat resizer disposed within the throat to increase air velocity.

85. The apparatus of claim 81, further comprising a hopper in communication with the inlet tube to receive material and convey material to the inlet tube.

86. The apparatus of claim 85, further comprising a heat generator in communication with the hopper.

87. The apparatus of claim 81, further comprising a sensor to monitor the material flow volume to the inlet tube.

88. The apparatus of claim 81, wherein the exhaust pipe is inclined at an angle from about 25 degrees to about 90 degrees relative to the longitudinal axis of the venturi.

89. The apparatus of claim 81, further comprising a flow control valve in the exhaust pipe.

90. The apparatus of claim 81, further comprising a restrictor disposed within the outlet to limit airflow.

91. The apparatus of claim 81, further comprising a second cyclone in communication with the first cyclone to receive air and separate residual particles.

92. The apparatus of claim 81, further comprising a condenser in communication with the cyclone to receive air and condense extracted moisture.

93. The apparatus of claim 81, further comprising a valve disposed on the diverging portion of the venturi to adjust the air volume and air velocity within the housing and the airflow generator.

94. The apparatus of claim 81, wherein the inlet tube has a first end in communication with free space, the first end configured as a flange.

95. The apparatus of claim 81, further comprising a mobile vehicle supporting the inlet tube, venturi, airflow generator, housing, exhaust pipe, and cyclone.

96. The apparatus of claim 81 wherein the housing further includes a diverter plate coupled to the interior of the housing proximate to the outlet and having a cutting edge proximate to the airflow generator.

97. The apparatus of claim 81 wherein an interior diameter of the inlet tube has approximately a two to one ratio with the interior diameter of the throat.

98. An apparatus for pulverizing material and extracting moisture from material, comprising:

a first inlet tube;

a first venturi coupled to the first inlet tube;

a first airflow generator to generate an airflow and including a first input aperture;

a first housing having a first outlet in communication with the first input aperture,

the first airflow generator in communication with the first venturi to direct an airflow through the first venturi, and toward the first input aperture, wherein material introduced into an airflow passes through the first venturi and is subject to pulverization and moisture extraction;

a first exhaust pipe coupled to the first outlet;

a first cyclone coupled to the first exhaust pipe to separate air from pulverized material;

a second inlet tube to receive pulverized material from the first cyclone;

a second venturi coupled to the second inlet tube;

a second airflow generator to generate an airflow and including a second input aperture,

a second housing including a second outlet in communication with the second input aperture,

the second airflow generator in communication with the second venturi to direct an airflow through the second venturi, and toward the second input aperture, wherein pulverized material introduced into an airflow passes through the second venturi and is subject to further pulverization and moisture extraction;

a second exhaust pipe coupled to the second outlet; and

a second cyclone coupled to the second exhaust pipe to separate air from pulverized material.

99. The apparatus of claim 98, further comprising a blender to blend material to be introduced into the first inlet tube.

100. The apparatus of claim 99, further comprising a conveyance device to convey blended material from the blender to the first inlet tube.

101. The apparatus of claim 98, further comprising:

a first hopper in communication with the first inlet tube to receive material and convey material to the first inlet tube; and

a second hopper in communication with the second inlet tube to receive pulverized material and convey pulverized material to the second inlet tube.

102. The apparatus of claim 101, further comprising a heat generator in communication with the first and second hoppers.

103. The apparatus of claim 98, further comprising a sensor to monitor the material flow rate to the first inlet tube.

104. The apparatus of claim 98, wherein the first and second exhaust pipes are inclined at an angle from about 25 degrees to about 90 degrees relative to the longitudinal axis of the corresponding first and second venturis.

105. The apparatus of claim 98, further comprising:

a first flow control valve disposed in the first exhaust pipe; and

a second flow control valve disposed in the second exhaust pipe.

106. The apparatus of claim 98, further comprising:

a third cyclone in communication with the first cyclone to receive air and separate residual particles; and

a fourth cyclone in communication with the second cyclone to receive air and separate residual particles.

107. The apparatus of claim 98, further comprising:

a first condenser in communication with the first cyclone to receive air and condense vaporized moisture; and

a second condenser in communication with the second cyclone to receive air and condense vaporized moisture.

108. The apparatus of claim 98, further comprising:

a first valve disposed on the first venturi to adjust air volume and air velocity within the first housing and the first airflow generator; and

a second valve disposed on the second venturi to adjust air volume and air velocity within the second housing and the second airflow generator.

109. An apparatus for pulverizing material and extracting moisture from material, comprising:

a first inlet tube;

a first venturi coupled to the first inlet tube;

a first airflow generator to generate an airflow and including a first input aperture;

a first housing at least partially encompassing the first airflow generator and having a first outlet in communication with the first input aperture,

the first airflow generator in communication with the first venturi to direct an airflow through the first venturi, and toward the first input aperture, wherein material introduced into an airflow passes through the first venturi and is subject to pulverization and moisture extraction;

a first exhaust pipe coupled to the first outlet;

a first cyclone coupled to the first exhaust pipe to separate air from pulverized material;

a second inlet tube to receive pulverized material from the first cyclone;

a second venturi coupled to the second inlet tube;

a second airflow generator to generate an airflow and including a second input aperture,

a second housing at least partially encompassing the second airflow generator and including a second outlet in communication with the second input aperture,

the second airflow generator in communication with the second venturi to direct an airflow through the second venturi, and toward the second input aperture, wherein pulverized material introduced into an airflow passes through the second venturi and is subject to further pulverization and moisture extraction;

a second exhaust pipe coupled to the second outlet;

a second cyclone coupled to the second exhaust pipe to separate air from pulverized material;

a third inlet tube to receive pulverized material from the second cyclone;

a third venturi coupled to the third inlet tube;

a third airflow generator to generate an airflow and including a third input aperture;

a third housing at least partially encompassing the third airflow generator and including a third outlet in communication with the third input aperture,

the third airflow generator in communication with the third venturi to direct an airflow through the third venturi, and toward the third input aperture, wherein pulverized material introduced into an airflow passes through the third venturi and is subject to further pulverization and moisture extraction;

a third exhaust pipe coupled to the third outlet; and

a third cyclone coupled to the third exhaust pipe to separate air from pulverized material.

110. The apparatus of claim 109, further comprising a blender to blend material to be introduced into the first inlet tube.

111. The apparatus of claim 110, further comprising a conveyance device to convey blended material from the blender to the first inlet tube.

112. The apparatus of claim 109, further comprising:

a first hopper in communication with the first inlet tube to receive material and convey material to the first inlet tube;

a second hopper in communication with the second inlet tube to receive pulverized material and convey pulverized material to the second inlet tube; and

a third hopper in communication with the third inlet tube to receive pulverized material and convey pulverized material to the third inlet tube.

113. The apparatus of claim 109, further comprising:

a third cyclone in communication with the first cyclone to receive air and separate residual particles;

a fourth cyclone in communication with the second cyclone to receive air and separate residual particles; and

a fifth cyclone in communication with the third cyclone to receive air and separate residual particles.

114. The apparatus of claim 109, further comprising:

a first condenser in communication with the first cyclone to receive air and condense vaporized moisture;

a second condenser in communication with the second cyclone to receive air and condense vaporized moisture; and

a third condenser in communication with the third cyclone to receive air and condense vaporized moisture.

115. The apparatus of claim 109, further comprising:

a first valve disposed on the first venturi to adjust air volume and air velocity within the first housing and the first airflow generator;

a second valve disposed on the second venturi to adjust air volume and air velocity within the second housing and the second airflow generator; and

a third valve disposed on the third venturi to adjust air volume and air velocity within the third housing and the third airflow generator.

116. An apparatus for pulverizing material and extracting moisture from material, comprising:

an inlet tube;

a venturi coupled to the inlet tube;

an airflow generator to generate an airflow and including an input aperture;

a housing at least partially encompassing the airflow generator and including an outlet in communication with the input aperture;

the airflow generator in communication with the venturi to direct the airflow through the venturi, and toward the input aperture, wherein material introduced into the airflow passes through the venturi and is subject to pulverization and moisture extraction;

an exhaust pipe coupled to the outlet;

a cyclone coupled to the exhaust pipe to separate air from pulverized material;

a diverter valve coupled to the cyclone and including a first diverter outlet and a second diverter outlet, the diverter valve alternatively directing pulverized material to the first and second diverter outlets; and

a recycling tube coupled to the second diverter outlet and in communication with the inlet tube to allow introduction of the pulverized material into the inlet tube and venturi.

117. The apparatus of claim 116, further comprising a blender to blend material to be introduced into the inlet tube.

118. The apparatus of claim 117, further comprising a conveyance device to convey blended material from the blender to the inlet tube.

119. The apparatus of claim 116, further comprising a throat resizer disposed within the throat to increase air velocity.

120. The apparatus of claim 116, further comprising a hopper in communication with the inlet tube to receive material and convey material to the inlet tube.

121. The apparatus of claim 116, further comprising a heat generator in communication with the hopper.

122. The apparatus of claim 116, further comprising a sensor to monitor the material flow volume to the inlet tube.

123. The apparatus of claim 116, wherein the exhaust pipe is inclined at an angle from about 25 degrees to about 90 degrees relative to the longitudinal axis of the venturi.

124. The apparatus of claim 116, further comprising a flow control valve in the exhaust pipe.

125. The apparatus of claim 116, further comprising a restrictor disposed within the outlet to limit airflow.

126. The apparatus of claim 116, further comprising a second cyclone in communication with the first cyclone to receive air and separate residual particles.

127. The apparatus of claim 116, further comprising a condenser in communication with the cyclone to receive air and condense extracted moisture.

128. The apparatus of claim 116, further comprising a valve disposed on the diverging portion of the venturi to adjust the air volume and air velocity within the housing and the airflow generator.

129. The apparatus of claim 116, further comprising a collector coupled to the first diverter outlet.

130. The apparatus of claim 116, further comprising a mobile vehicle supporting the inlet tube, venturi, airflow generator, housing, exhaust pipe, cyclone, diverter valve and recycling tube.

131. The apparatus of claim 116, wherein the housing further comprises a diverter plate coupled to the interior of the housing proximate to the outlet and including a cutting edge proximate to the airflow generator.

132. An apparatus for providing an airflow, comprising:

an airflow generator including,

a front plate,

an input aperture disposed within the front plate,

a back plate, and

a plurality of blades disposed between and coupled to the back and front plates; and

a housing at least partially encompassing the airflow generator and including,

a housing outlet communicating with the interior of the housing, and

a diverter plate coupled to the interior of the housing and having,

a first end proximate to the housing outlet, and

a cutting edge proximate to the airflow generator.

133. The apparatus of claim 132 wherein each blade transitions from a position perpendicular to the back plate to an inclined position as the blade proceeds to the input aperture.

134. The apparatus claim 133 wherein the angle of the inclined position of each blade is approximately 20 to 60 degrees from a position perpendicular to the back plate.

135. The apparatus of claim 132 wherein each blade includes a wedge portion disposed proximate to a perimeter of the front and back plates, the wedge portion having a thickness greater than the remainder of the corresponding blade.

136. The apparatus of claim 135 wherein each wedge portion increases in thickness as it extends longitudinally from the front plate to the back plate.

137. The apparatus of claim 135 wherein each wedge portion includes a removable wear tip.

138. The apparatus of claim 135 wherein each wedge portion is removable to allow replacement.

139. The apparatus of claim 132 wherein each blade includes a leading edge proximate to the input aperture and a tail edge proximate to a perimeter of the front and back plates, the leading edge having an outward curve portion proximate to the back plate and an inward curve portion proximate to the front plate.

140. The apparatus of claim 139 wherein the leading edge includes an oval shaped cross-section.

141. The apparatus of claim 132 further comprising a plurality of fins disposed on exterior surfaces of the front plate and the back plate.

142. The apparatus of claim 132 wherein the diverter plate is adjustably coupled to the interior of the housing to vary the distance from the cutting edge to the airflow generator.